CALIFORNIA ENERGY COMMISSION

2013 Building Energy Efficiency Standards Staff Workshop

Single Family DHW Distribution System Enhancements & Showerhead Requirements

California Energy Commission

June 9, 2011

Background

- Proposal sponsored by the California Statewide Utilities Codes and Standards Program as a Codes and Standards Enhancement (CASE) study

- Single Family CASE study author: Marc Hoeschele, DEG
- Presented at stakeholder meeting May 13, 2011 and at May 24, 2011 Title 24 Staff Workshop

- Showerhead CASE study author: Owen Howlett, HMG

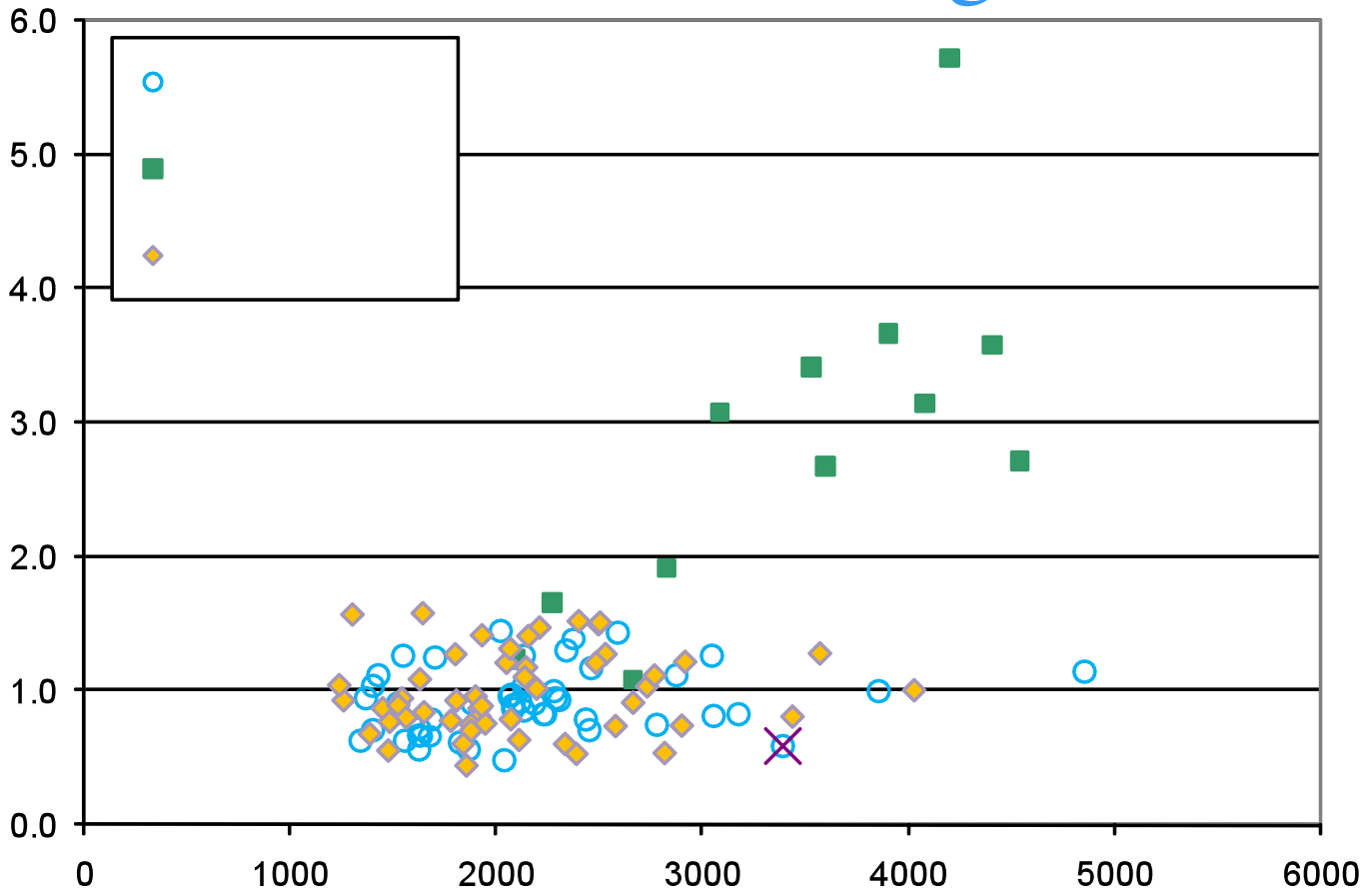
Overview - Single Family DHW Distribution System Enhancements

- Summary of May 24th Proposal
- New information
- Specific code change proposals

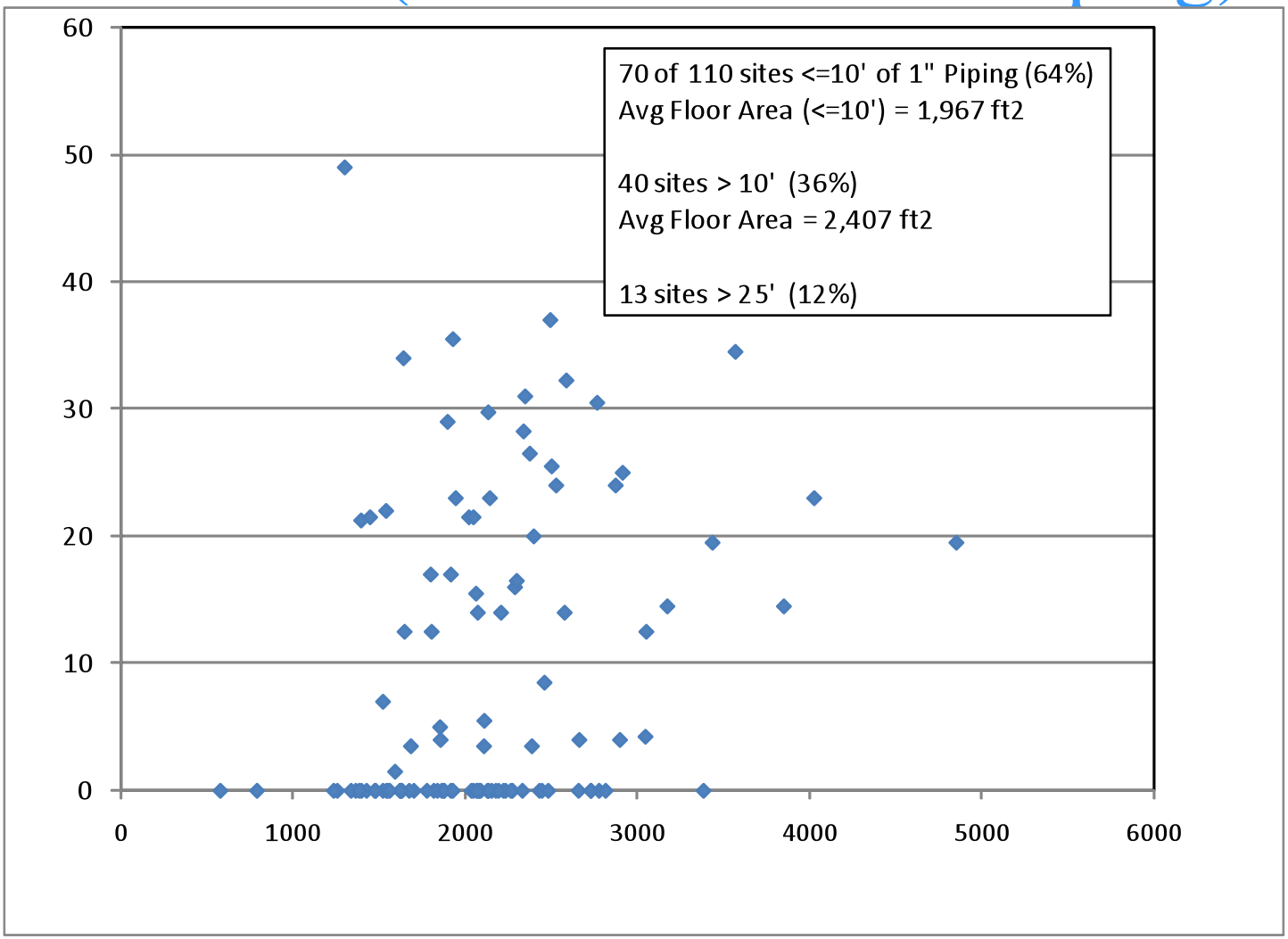
Code Change Proposals

- All ¾" and larger piping to be insulated
- Limit 1" piping to a maximum 10' length
- Make compact hot water distribution systems the prescriptive standard; allow for efficiency offramp
- Update ACM
  - Recalibrate ACM projected usage with RASS
  - New ACM relationships and DSMs
- Add HERS inspection for some measures

Field Data / Findings



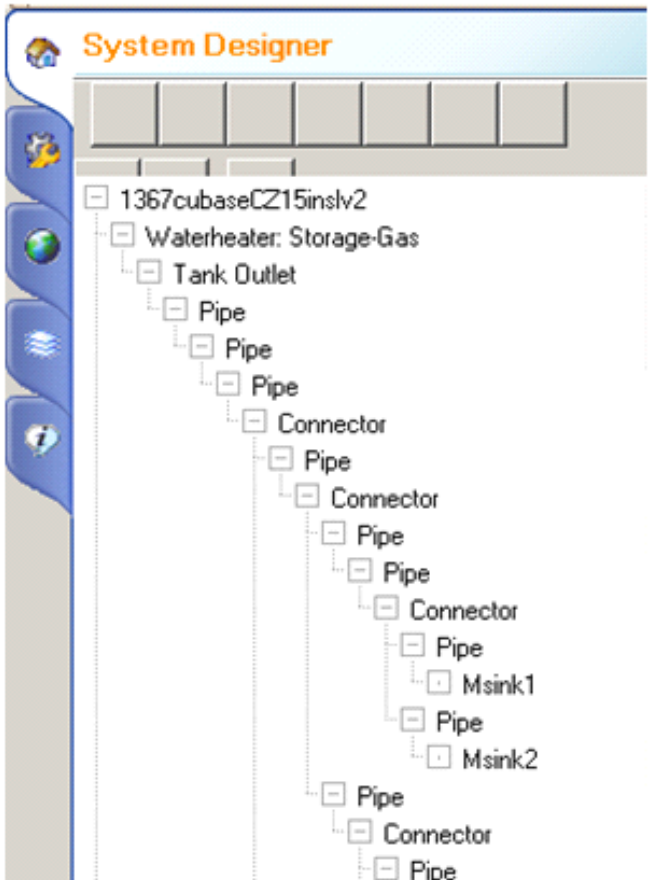
Field Data (Prevalence of 1” Piping)

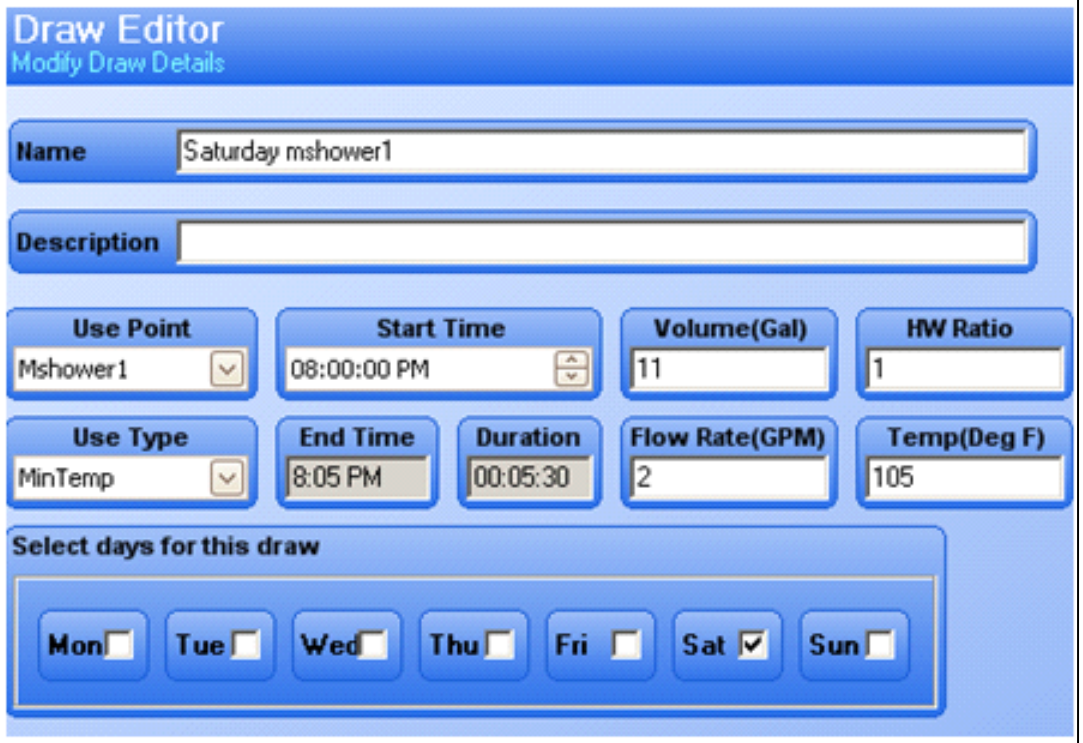


Data/Findings

- What do the field findings tell us?
  - Need to reduce large diameter piping length (i.e entrained volume)
  - Need to insulate piping where cost effective
  - Need to promote compact hot water distribution system (HWDS) designs

Analysis Approach- HWSIM





LCC Analysis Results

Insulated piping >= ¾ inches	BCR = 1.53
Limit 1" Piping to 10'	BCR = 1.78
Compact HWDS	BCR = 2.11

- Locate WH more centrally
- In some cases, modify house design
- Tighten up the plumbing layout

Proposed Requirements

Mandatory Requirements

Insulated piping >= ¾ inches

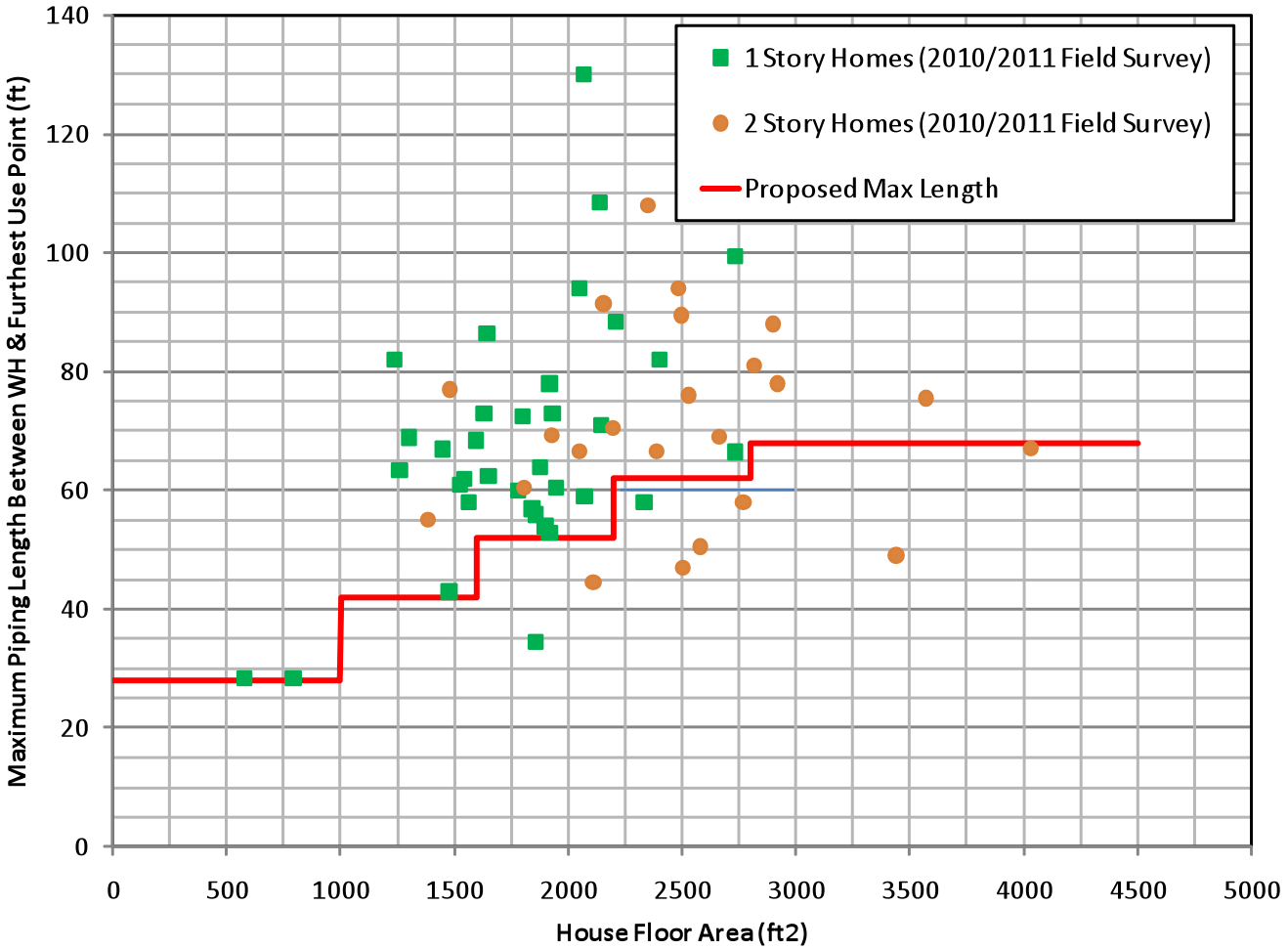
Limit 1" Piping to a total of 10' in non-recirculating systems

Prescriptive Requirement

Compact HWDS (with WH efficiency offramp)

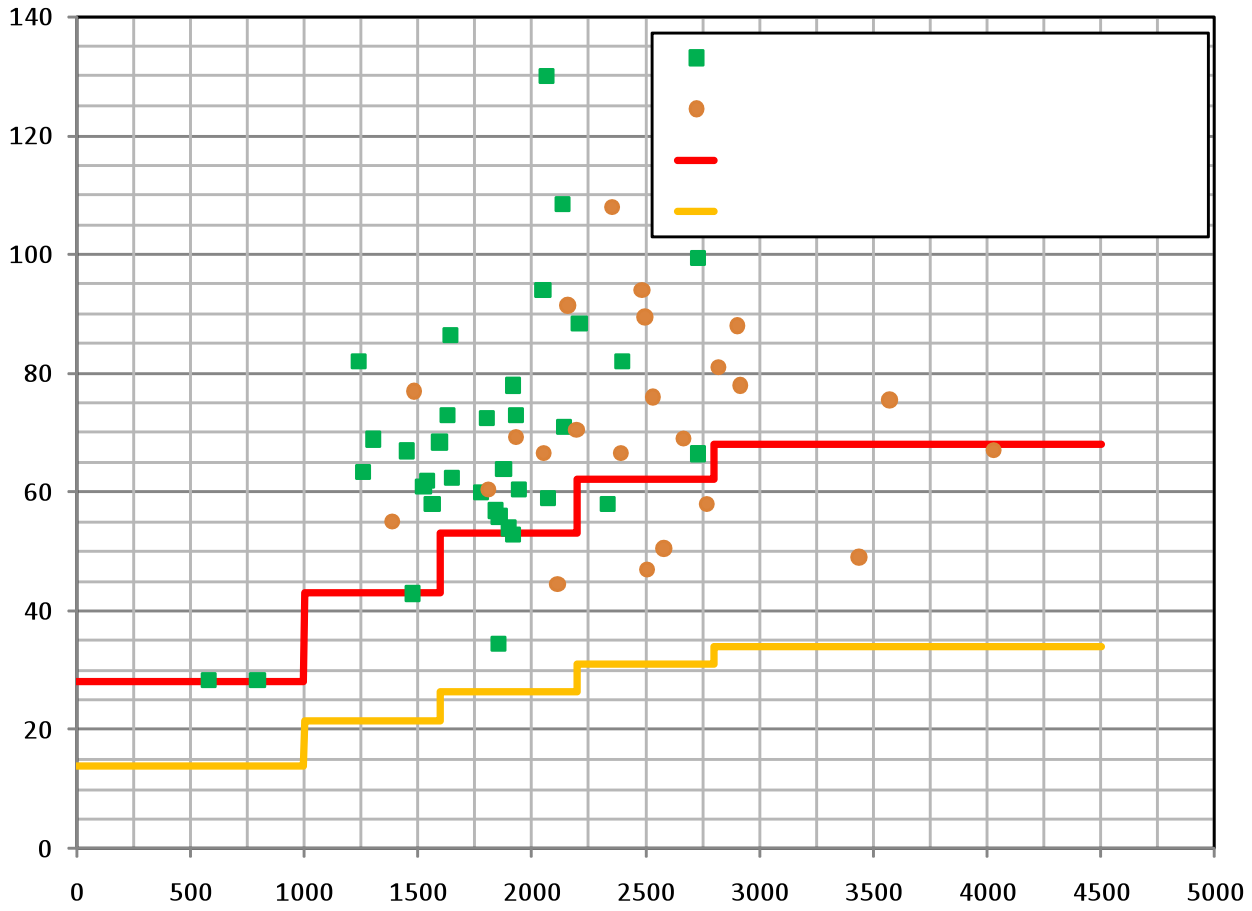
May 24th Compact HWDS Proposal

Proposal Relied on Max Pipe Length and Field Verification



June 9th Compact HWDS Proposal

New Proposal- Plan Check Review + Field Verification (with offramp)



Compact HWDS Offramp

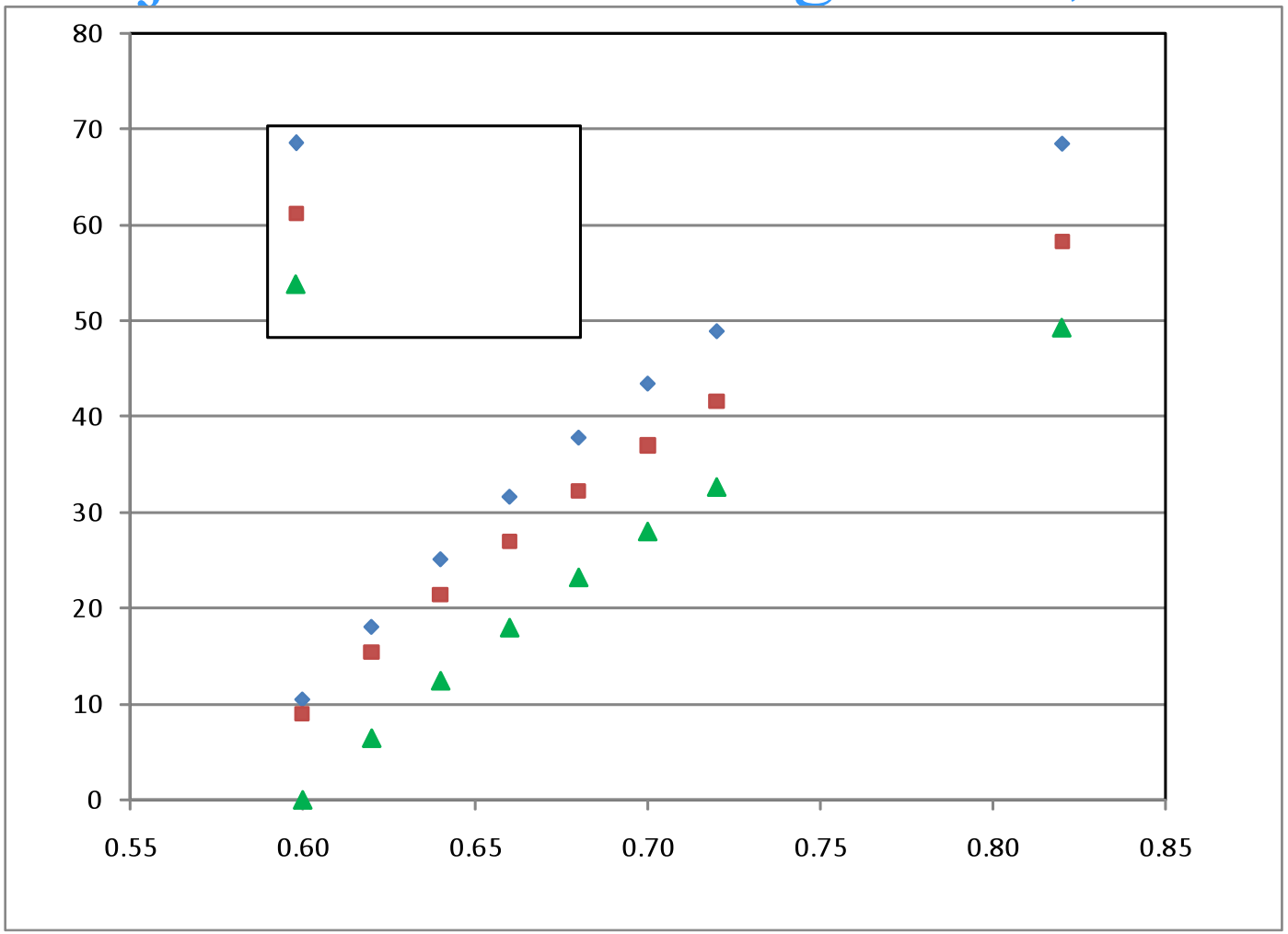
Incremental Savings of Compact HWDS ~ 8 – 12 therms/year

In lieu of Compact strategy, install a higher efficiency water heater to offset lost savings; Installed EF of water heater would increase by ~ 0.02 to 0.04.

Gas Water Heater Efficiency Levels

Water Heater Type	Energy Factor
Non Condensing Natural Draft	Up to 0.63 EF
Non Condensing Power Vent	Up to 0.67 EF
Condensing Storage	~ 0.75 to 0.85 EF
Tankless	~ 0.80 to 0.85 EF
Condensing Tankless	~ 0.90 to 0.95 EF

Projected ACM Savings for 1,761 ft^2



Code Change Proposal

Section 150 (j)2 mandatory measures

- Add pipe insulation requirement (>= 3/4 inch lines)
- Limit 1” pipe length in non-recirculating systems to a maximum of 10 feet (with exception for large tubs)

RACM Appendix E

- Update to reflect changes in fixture end use, standard distribution loss, water heater setpoint, and DSMs. Updated DSMs will reflect compact hot water distribution system as standard design.

Code Change Proposal

Section 151 (b) Water Heating Budgets

The prescriptive standard for distribution system performance will be based on a compact hot water distribution system approach which limits the maximum length of distribution piping between the water heater and the furthest use point in the house. The table below defines the maximum pipe length as a function of Floor Area Served, where Floor Area Served equals the conditioned floor area divided by the number of installed water heaters. The maximum length must be verified both in plan check (plan view distance) and with HERS field inspections (actual piping length).

Floor Area Served (ft2)	Maximum Length (feet)	
	Plan View	HERS Field
<1001	14	28
1001-1600	21	42
1601-2200	26	52
2201-2800	31	62
>2800	34	68

Overview - Showerheads

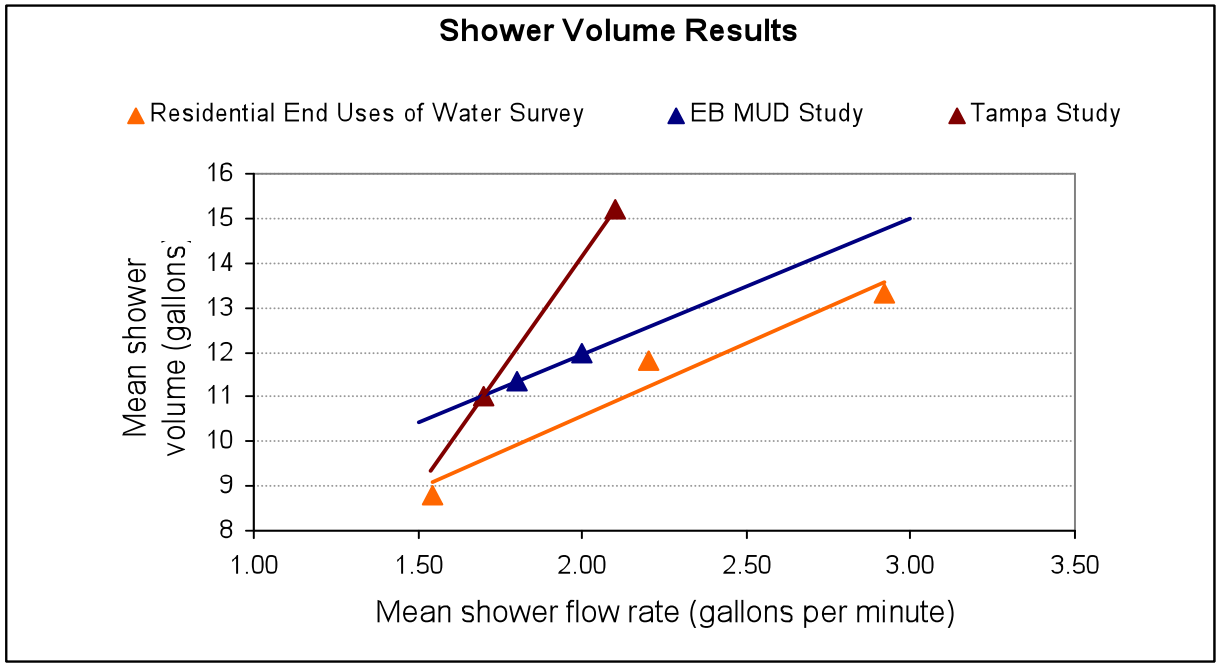
- Summary of proposed changes
- Supporting data and energy analysis
- Cost-effectiveness
- Specific code change proposals

Code Change Proposals—Showerheads

- Limit shower head flow rate in new construction to 2.0gpm at 80psi, in line with CalGreen and the Federal WaterSense standards.
- Require one shower valve per shower elbow, so that multiple heads can't be controlled from a single point. The intent is to limit the flow rate to 2.0gpm per person as much as possible.
- Note that Federal interpretation of existing A112.18.1M-1996 standard takes effect 2012 to eliminate multi-head showers supplied by a single pipe.
- Also note that the proposed requirement that pipes be no wider than ½" at any point has been dropped.

Energy and Water Savings

– Lower flow shower heads result in longer (measured) shower durations but reduced energy and water use



Energy and Water Savings

– A reduction from 2.5 to 2.0 gpm gives an average reduction of 2.6 gallons and 8.6 therms per day per capita

Study	Flow Rate Reduction, relative to Federal 2.5gpm standard	Shower water savings relative to Federal 2.5 gpm standards (gal/day)	Energy savings (therms/yr/shower head)
REUWS	0.6	3	9.6
EBMUD	0.2	0.6	1.9
Tampa	0.4	4.2	13.5
Tachibana and Schuldt	0.7	2.2*	7.1
Weighted Average (based on sample sizes)	0.6	2.6	8.6

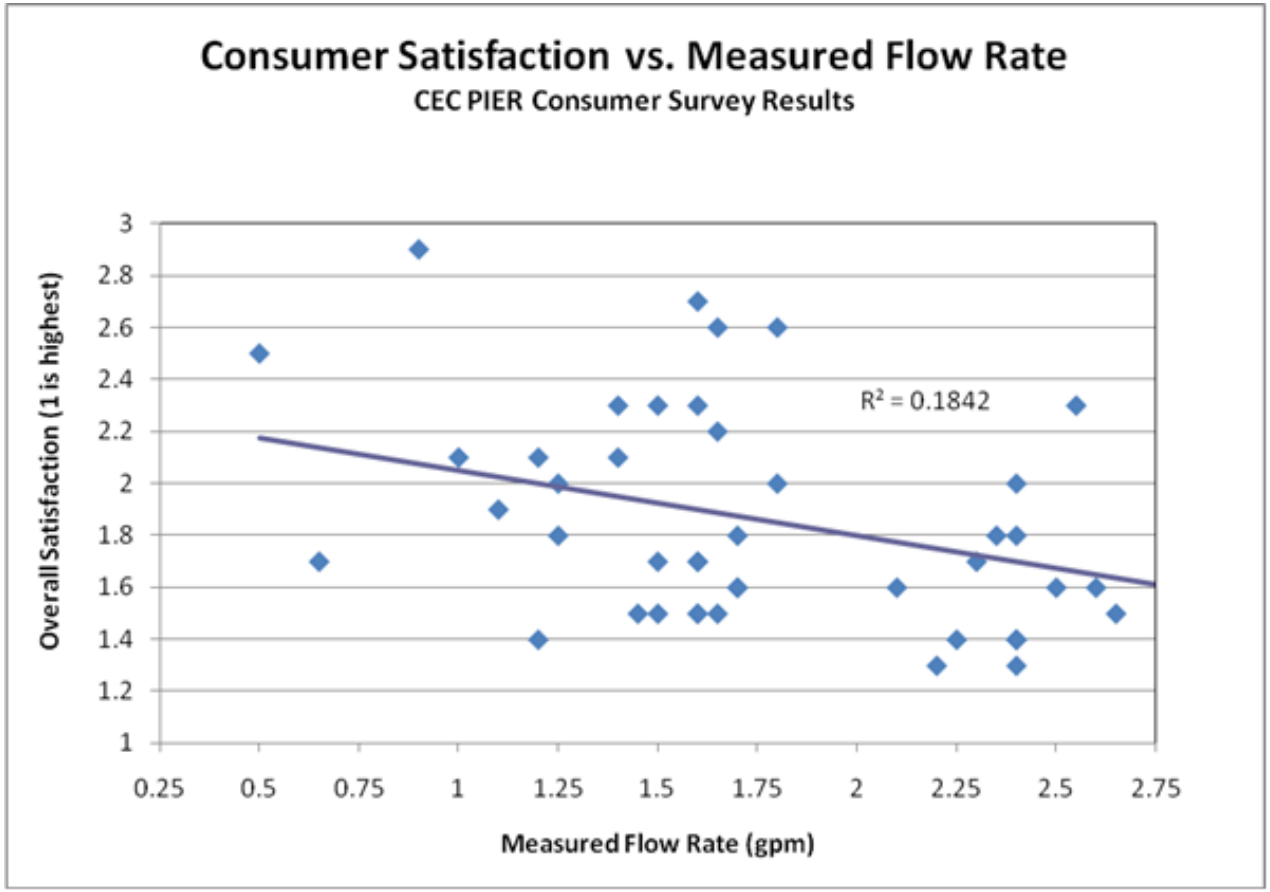
User acceptance

- Two field studies
  - Aquacraft , Inc., 2004. Tampa Water Department Residential Water Conservation Study
  - Tachibana, D, Schuldt, M. 2008. Energy-Related Water Fixture Measurements. Seattle Public Utilities.
- One lab study
  - Robert Mowris and Associates, PIER study, 2010

User acceptance

- Field studies both found very high user acceptance of new (retrofit) low flow shower heads. Tachibana and Schuldt:
  - 69% very satisfied, 23% somewhat satisfied, 4% not too satisfied, 4% not at all satisfied
- Lab study found a small user preference for higher flow over lower flow shower heads
  - Blind study, within-subjects design with randomized order of presentation

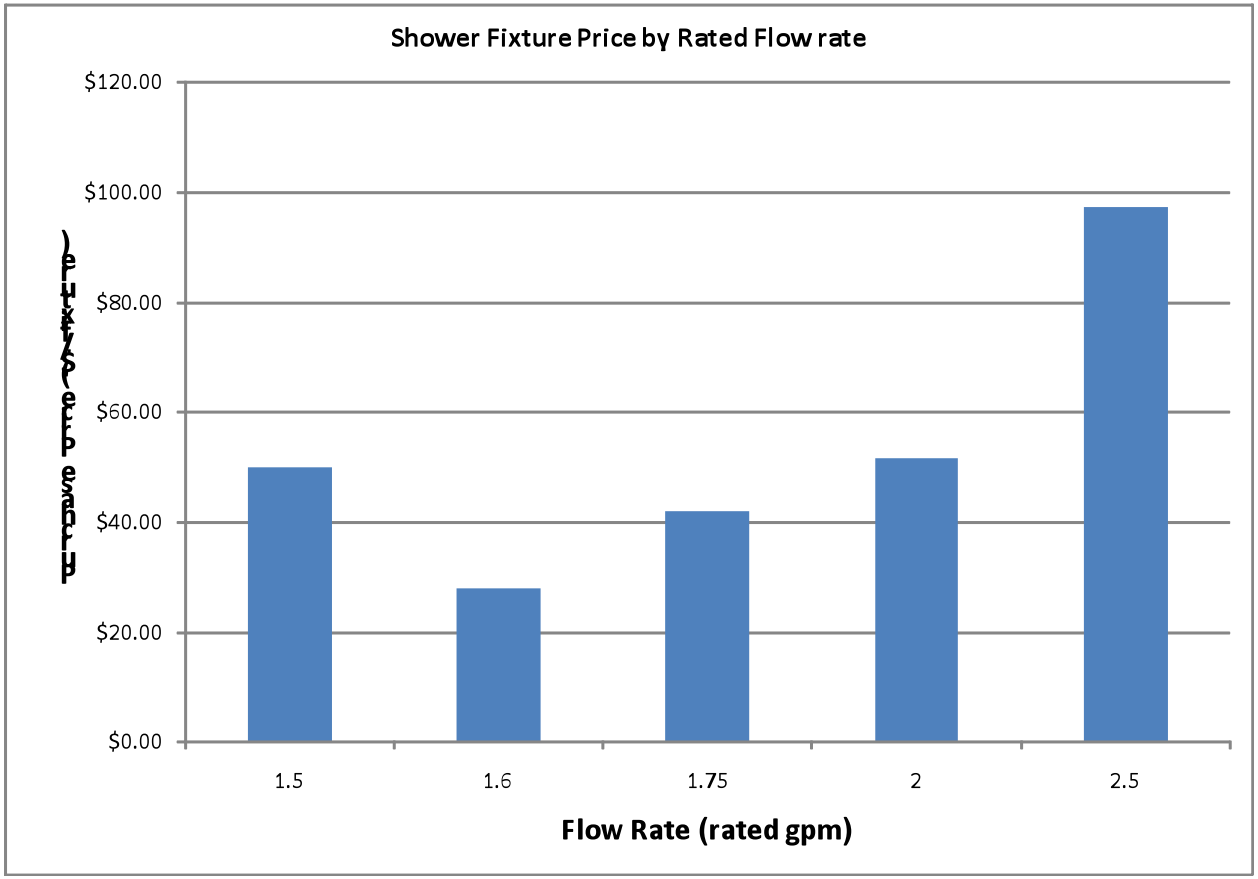
PIER study user satisfaction results



Pricing and availability

- Survey of the complete product range of 22 manufacturers
  - 116 models with a 2.2 gpm average flow rate
- Purchase price is not dependent on rated flow rate
  - lower flow shower heads mostly use the same components as regular shower heads (though modified to deliver less water).
- Higher flow rate shower heads are actually more expensive on average because of premium designs and finishes offered only on 2.5gpm heads

Survey results: average retail price by flow rate category



Multi-Head Showers—Prevalence

- Seattle Public Utilities, 2006 Residential Water Conservation Benchmarking Survey
  - 15% of respondents reported having showers with multiple heads or nozzles:
    - 47% had two nozzles
    - 24% had three nozzles
    - 20% had four or more nozzles
  - The average number of nozzles per multi-head shower was 2.6, which at a flow rate of 2.5gpm (standard) per nozzle gives 6.5gpm average flow rate
- Biermayer, 2006
  - Based on published manufacturers' flow rates, the mean flow rate for multi-head showers is likely to be around 5.5gpm.

Multi-Head Showers—Prevalence

- AIA's Home Design Trends Survey (2008), has found consistently over the past four years that architects report specifying more multi-head showers in the houses they design. However, the survey reports only whether there has been a change, and does not give any estimate of the number of multi-head showers being installed.
- We did not find any statistical evidence regarding penetration of multi-head showers into commercial construction (i.e., hotels and motels).

Multi-Head Showers— Energy and water savings

- Eliminating a typical multi-head shower saves around 25 gallons per person per day, and 80 therms.

(All data reported is on per capita basis)	Average Fixture Flow rate (gpm)	Shower Use (gal/day)	Water use above Federal Std (gal/yr)	Potential Savings (therms/yr/shower head)
Seattle Public Utilities	6.5	25.7	9381	82
Biermeyer	5.5	22.6	8249	73
REUWS (Non-Low Flow houses)	2.9	13.3	4855	43

Proposed Language

- Section 101
  - SHOWER HEAD is a fixture for directing the spray of water in a shower. A shower head may incorporate one or more sprays, nozzles or openings. All components that are supplied standard together and function from one inlet (i.e., after the mixing valve) form a single shower head

Proposed Language

- SECTION 113(c)7 Shower Heads.
  - A single shower head must be installed for each shower mixing valve. Shower heads must have a rated flow rate of no more than 2.0 gallons per minute at 80 psi.
  - EXCEPTION to Section 113(c)7: Showers that recirculate hot water from the drain to the shower head.

2013 Standards Update

Send related comments by July 8, 2011 to:

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